Light and Lighting

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Peace At Last

FEW would have foreseen, even at the commencement of this month, the end of hostilities in the Far East.

Now at last, after six years of war, the process of rebuilding of what has suffered may be begun in earnest. Reconstruction is no longer a distant vision though much patience may still be necessary before it becomes an accomplished fact.

In the field of lighting the restoration of street lighting to something like pre-war standard has been a great encouragement, and we look for further progress—as well as the full restoration of supplementary aids such as shop window lighting, flood-lighting (of which citizens got a glimpse on V-Day) and illuminated signs.

In the field of interior lighting vast scope for progress exists, since for six years, effort has been concentrated almost entirely on the industrial field. In almost all other directions there has been marking time, or even deterioration.

In all these things progress must wait upon the provision of equipment. Still later there will come new advances, not only the coming of new fluorescent lamps, which we may confidently expect in the near future, but ultimately (who knows ?) entirely new sources based on the controlled release of atomic energy—so dramatically revealed by recent events,

Proposed I.E.S. Convention, May, 1946

Readers will learn with great interest of the proposal to hold a special "I.E.S. Convention" in London in May, 1946. This Convention should furnish an opportunity for I.E.S. members to gather together—and amongst them will doubtless be many now with the Forces who will by then have returned to civil life.

The Convention is visualised as covering about two and a half days and taking the form of a number of social events built round two main technical features. Among the special events it is hoped to include a reception by the president, a dinner, a more "frivolous" evening entertainment, and possibly outings and sporting events. The two main technical features will be a Conversazione linked with an Exhibition, and sessions devoted to papers of broad interest. In both these features the themes will be *firstly* what light has done for the nation during the war, and *secondly*, what lighting can do in the post-war period, based on knowledge gained as a result of special wartime activities. It is suggested that the exhibits, after being open for inspection by I.E.S. members following the president's reception, might be available for visits by selected bodies of persons outside the ranks of the Society. The success of the Convention necessarily depends upon the wholehearted co-operation of all I.E.S. members, many of whom may be aware of special work which would lend itself to inclusion in the Conversazione, either in the form of demonstrations or pictorially. For the moment, the aid of all members is sought chiefly in connection with the Exhibition, and any suggestions will be gratefully received. Similar suggestions for papers to be read or discussed at the Convention will likewise be welcome. Such papers may be long or short, specialised or generalised, and may cover the war or the future, with special emphasis on how war experiences need not be lost in peace. All such suggestions should be sent in to the honorary secretary as soon as possible.

"Let Us See"

By the courtesy of the I.E.S. in America, a copy has now been received of the film bearing the above title and intended to illustrate the benefits of good industrial lighting. It is expected that the film will be shown at a meeting in London early in the autumn. Subsequently I.E.S. Centres may wish to make use of it, and the film will be available for display—on the understanding, however, that care is taken to ensure that all necessary precautions are taken in doing so. (Films are easily damaged by inexpert treatment!)

Ambrose Fleming

By the passing away, at the advanced age of 95 years, of Sir Ambrose Fleming, the field of electrical engineers recently lost another of its great figures, responsible for many great discoveries and closely linked with the early history of the electrical industry. A pleasing tribute to him is paid in *Electronic Engineering* by Professor J. T. MacGregor-Morris, one of his first students, who later became his personal assistant at University College. The author recalls several striking or amusing incidents of those early days, such as the demonstration, by primitive means, of the wave form of a telephone speaking current, at a time when the Duddell oscillograph was unknown. An early experiment with a Crookes tube revealing the possibility of magnetic focusing and a demonstration of the defects of a.c. wattmeters (at a time when an I.E.E. discussion might last for six weeks!) are also mentioned. Much of Sir Ambrose's early work was accomplished with simple apparatus—he once remarked that all the authorities provided for him was a blackboard and a piece of chalk. Also associated with him for many years was another I.E.S. member, now unhappily no longer with us, Professor W. C. Clinton. Sir Ambrose Fleming's enthusiasm for scientific research continued right up to the end of his long life. Professor McGregor-Morris reproduces a portion of a letter from him, written shortly before attaining his 95th birthday.

The Art of Writing a Paper

Over 100 I.E.S. meetings now take place annually. There must therefore be quite a number of members who have been or are likely to be concerned with the writing of papers. To them a recent contribution on the above subject by Mr. Lawrence H. A. Carr* may be commended. People are apt to under-estimate the effort of preparing a good paper. Mr. Carr suggests that several drafts are necessary. A conscientious author may well write the paper three times. He should first evolve a clear line of thought, adopt a series of headings, and commence the initial draft, forming the basis of the paper. The opening and closing sentences (obviously important) may be left to a later stage. In the second stage details and references should be verified. The sequence should be improved where necessary, and the paper should be cut down ruthlessly by the omission of everything that is not strictly necessary. The phrase "This will be explained later" is a danger signal that should not be ignored. Most articles when first written are far too long. In the third and last draft improvement in the English should be studied. Mr. Carr emphasises the importance of acquiring a good style and mentions books worth study in this connection. Sentences should be kept short. Poetical phrasing and, in particular, interjectory expressions ("Lo and behold") should not be used. Care should be taken to avoid slang or colloquialisms.

*The Art of Writing a Paper, by Laurence H. A. Carr, Inst. Elec. Engrs. Students' Quarterly Jour. June, 1944.

Personal Notes

Dr. W. D. Wright (see p. 115) is again undertaking a special series of lectures at the Imperial College of Science and Technology, dealing this time with colour in various aspects. It is encouraging to note the initiation of lectures such as these, and we hope they will receive widespread support.

We learn with pleasure that W/O R.A. Eshelby, R.A.F., whose aircraft was shot down into the North Sea during the Scharnhorst-Gneisenau Channel action in 1942, has now returned from Germany as a liberated prisoner of war. Upon demobilisation he is returning to the "Philora" discharge lighting department of Philips Lamps, Ltd.

I.E.S. members will be interested to learn that the O.B.E. has been conferred on Mr. A. Blok, who has been engaged on special scientific work of national value. Mr. Blok is an I.E.S. member of long standing, who on several occasions has served on joint committees concerned with lighting problems

Sergei Vavilov

A Great Russian Scientist

We are indebted to Mr. James M. A. Mitchell, a past chairman of the I.E.S., Newcastle Centre, for drawing our attention to an interesting account of the career of Sergei Vavilov, the new President of the Academy of Sciences of the U.S.S.R. ("Soviet News," July 24, 1945). Vavilov graduated from Moscow University, and since 1932 has been director of the Institute of Physics, and has also become deputy director of the State Institute of Optics. His work has been largely concerned with optics, and during the war he designed many complex optical instruments for the Red Army, Air Force, and Navy. Of special interest, however, is his study of the basic features of luminescence, a theory of which, based on the resonance interaction of molecules, he has developed. Vavilov is identified with the study of luminescent analysis, now being increasingly applied in medicine, geology, and industry, and has been responsible for the development of gas-filled lamps covered with luminescent powders and converting u.v. radiation into visible light. To Vavilov is also attributed certain fundamental work on radiation such as the visual method of observing quantum fluctuations of light and the discovery of a special type of luminosity which arises in some media when the electrons move within them at a speed surpassing that of light in the same media. One learns with interest of the work of this scientist. It is all too seldom that information is broadcast regarding the efforts of experts on optics and illumination in the U.S.S.R. We have been made aware of the fearful destructive force of atomic energy, but we may well hope that it will also prove to have valuable uses in peace —perhaps in the lighting field.

The Lighting of Buildings

We notice in "Illuminating Engineering" (June, 1945, p. 326) a summary of the Postwar Building Study, No. 12 (The Lighting of Buildings), which is now familiar and which was discussed before the Illuminating Engineering Society in London last February. The summary was contributed by Mr. W. R. Stevens, one of the British reporters to the Committee on Papers of the American I.E.S. Mr. Stevens, of course, has a detailed knowledge of this report and has done good service in thus making its contents better known in the U.S.A.

No doubt there will be other similar opportunities for action in the future.

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Printers' and Authors' Proof Corrections

We are occasionally asked for information on procedure in correcting proofs of papers and articles and take this opportunity of referring those interested to an excellent little publication, British Standard 1219, 1945. We confess it was something of a surprise to learn that the B.S.I., whose net is cast so wide, had also taken proof correcting under its wing. Copies of this booklet (price 2s. post free) may be obtained from the British Standards Institution, 28, Victoria-street, London, S.W.1. It is explained in the introduction that the issue of this specification was prompted by the recognised need for standard practice—not only by printers but also by editors and authors. The pamphlet contains a complete list of symbols and specimens of corrected text. There are also some helpful general recommendations on the preparation of copy for the printer.

Measurement of the Photometric Properties of the Upper Atmosphere

By J. M. WALDRAM, B.Sc., F.Inst.P. *(Fellow)*

(Trans. Illum. Eng. Soc. (Lond.), August, 1945)

It will be recalled that an abridged version of the above paper appeared in the June issue of the Transactions. The complete version is now published in the Transactions for August, 1945.

In view of the situation created by the Paper Restrictions, it has been decided to limit the distribution of this issue of the Transactions, which will be sent to the libraries and such bodies as require the Transactions for permanent reference, but only to those I.E.S. members who make application for it (which all members who are in the habit of retaining copies and binding them in volume form will naturally do).

Members who wish to receive the August issue of the I.E.S. Transactions are accordingly requested to fill up and return to the Hon. Secretary the attached form.

It will be recalled that, in announcing similar procedure in regard to Dr. Nelson's paper on "The Automobile Headlamp" (see "Light and Lighting," March, 1945), it was mentioned that this practice might possibly be adopted in the case of other papers of a lengthy and somewhat specialised nature. Besides easing the situation in regard to paper, this practice may facilitate the publication of more papers of wide and general interest.

This form to be returned to the Hon. Secretary of the Illuminating Engineering Society, 32, Victoria Street, London, S.W.1.

I.E.S. Transactions, August, 1945.

Please send me the issue of the Transactions for August, 1945, containing Mr. J. M. Waldram's paper entitled "Measurement of the Photometric Properties of the Upper Atmosphere."

Signature of Member.....

.....

Name and Address to which copies should be sent.

In clear block letters.

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Lighting Reconstruction Pamphlets

Readers are reminded that copies of the series of Lighting Reconstruction Pamphlets are still available on application to the Illuminating Engineering Society (32, Victoria-street, London, S.W.1).

It will be recalled that the first five of the series are all available at the same rate (single copies 1s. each, 9s. per dozen, £3 per 100). The titles are as follows: No. 1, "The Principles of Good Lighting"; No. 2, "The Lighting of Public Buildings"; No. 3, "The Lighting of Schools"; No. 4, "Natural Lighting"; No. 5, "Public Lighting in the City and Highway."

The sixth of the series, "Making Work Lighter," which carries illustrations by Fougasse, is issued at the special flat rate of 6d. a copy.

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Extraneous Lighting in the Vicinity of Airfields Aerial Beacons and other Light Beacons

Memorandum by the Air Ministry and Ministry of Civil Aviation

The Air Navigation Act, 1920, as amended, and the Air Navigation (Consolidation) Order, 1923, as amended, include provisions requiring that

(a) Any light exhibited in the vicinity of an aerodrome, which by reason of glare is likely to endanger aircraft arriving at or departing from the aerodrome, and

(b) Any light which is liable to be mistaken by the crew of an aircraft for an aerial lighthouse, or for a light or part of a system of lights used for air navigation, shall be extinguished or effectively screened on the direction of the Secretary of State or the Minister of Civil Aviation.

Similar provisions as to dangerous lights are included in the Final Act of the International Civil Aviation Conference held at Chicago in November and December, 1944.

2. Now that war-time lighting restrictions have been relaxed, a progressive return to full-scale lighting throughout the country is to be expected. The Air Ministry and Ministry of Civil Aviation have no wish to impose unnecessary controls, but it is imperative that there should be no interference with the safe operation of air traffic, which must be capable of functioning regularly under all weather conditions. To avoid unnecessary expenditure on the part of local authorities, manufacturers of equipment and others concerned, and to obviate the need, on the part of the Secretary of State for Air and the Minister of Civil Aviation, to have recourse to their statutory powers, the Air Ministry and Ministry of Civil Aviation wish to offer some general guidance on the limitations on highway lighting, etc., which they consider desirable in the vicinity of airfields, aerial lighthouses, and other light beacons. To achieve their objective they would welcome the co-operation of the Association of Public Lighting Engineers, the Illuminating Engineering Society, and the British Standards Institution.

3. The two main classifications of lights which will be affected are

(i) Highway lighting including road traffic control light signals.

(ii) Illuminated signs.

A definite indication of the required limitations on the former can easily be given, but the latter can only be dealt with in general terms. This is due to the lack of adequate control by local authorities over the erection and operation of signs. This is dealt with at greater length below.

4. To appreciate the general problem it is essential to realise the changes that have occurred in aviation in the past six years. Light aircraft of low speed and low wing loading have been largely superseded by heavier aircraft of higher speed and higher wing loading of the order of 45 lb. per square foot. These developments have entailed a complete change of technique—from a close circuit of an airfield and a steep descent to a wide circuit and a long, straight, shallow approach to the airfield. Further, the development of radio has made it possible to operate aircraft in all weather conditions both by day and night. It has not, however, enabled *all*

pilots to dispense entirely with visual aids for navigation, landing, and take-off purposes. It is, therefore, of the utmost importance to avoid any source of confusion to a pilot, in the interest not only of maintaining scheduled services, but also of preventing accidents which might well endanger aircraft with their crews and passengers, as well as persons and property on the ground.

5. Aviation ground lighting may be divided into three categories:—

(i) Navigational lights.

(ii) Those lights outside the boundaries of an airfield and connected with the approach thereto.

(iii) Those lights actually located on the airfield itself.

The functions of these categories are explained briefly below:—

(a) Navigational Lights.—These may include aerial lighthouses and any form of light beacon which is operated to provide navigational assistance to the crew of an aircraft in establishing their position.

(b) Approach Lights are installed for the express purpose of leading pilots to an airfield. In low visibility conditions they are used in conjunction with some form of radio aid, but in good conditions normal contact flying will prevail. Generally the approach lights will extend to a distance of some 3,000 yards from the runway end and will be in the form of an avenue of lights slightly diverging outwards as the distance from the runway increases. The lights themselves may be coloured red or yellow.

(c) The lights on the airfield will include those outlining the runway, taxi-ways, etc., together with any visual signal devices, that may be necessary to establish communication between the airfield control and aircraft in the air or on the ground. The runway lights may be either uni-directional or visible through 360° in azimuth, and obviously will be required to project the light above the horizontal.

6. With such a conspicuous pattern and regularity of feature, it might be thought that there would be no possibility of confusion between airfield lighting and normal highway and domestic lighting. Experience, however, has proved otherwise. There have been cases of pilots mistaking a road traffic control light for light signals from the Airfield Controller and of making approaches on what were, in fact, well-lit highways. It will be seen, therefore, that there is an element of risk which must be overcome. It is considered that control of lights in the vicinity of an airfield is essential.

7. The suggested action to be taken by local authorities to prevent street lighting from confusing air crews is summarised below. If these suggestions are put into practice by local authorities, it is considered that the requirements of the Air Navigation Acts would be fulfilled:—

(a) Highway Lighting.—Lights within 3,000 yards of the boundary of the landing area of an aerodrome should be screened so that the light source will not be visible above the horizontal. Where the lights are on a gradient, they should be screened at such an angle as to prevent any possibility of the lights being seen as a regular pattern from the air.

(b) Road Traffic Control Signal Lights should be screened in conformity with the Home Office Instructions for daylight operation during black-out conditions (i.e., the bottom half of the signal lenses should be obscured by the half-moon and the top of the lenses should be screened with the long hoods).

8. In paragraph 3 above reference was made to illuminated signs. It is understood that no local regulations exist which govern the actual pattern and operation of signs as distinct from the manner in which they are erected. It will be readily appreciated that from a distance a flashing neon sign could quite easily be mistaken for some form of flashing red light beacon. In addition there is the chance that a revolving

white advertisement could be mistaken for an aerial lighthouse or other form of light beacon. It is, therefore, essential that no lights which could in any way be confused with an aerial lighthouse or with a system of airfield and approach lighting approved by the Air Ministry or the Ministry of Civil Aviation should be permitted. In view of the speed of modern aircraft, it is also an essential safety precaution that no light which, by reason of its characteristics, would be likely to confuse a pilot, should be installed within a radius of five miles from an approved system of airport and approach lighting, or within a radius of 100 miles from an aerial lighthouse.

9. As regards illuminated advertisements in the vicinity of airfields, it is considered that the usual type will not conflict with the normal approach and airfield lighting, but care must be taken to ensure that advertisements will in no way be mistaken for airfield control signals. Where such confusion is possible, it is suggested that advertisements utilising any small flashing or occulting red, green or white light should be provided with a screen to prevent observation from above the horizontal or from within the boundary of the airfield.

10. The Air Ministry and the Ministry of Civil Aviation would be grateful if the Association of Public Lighting Engineers and the Illuminated Engineering Society would circularise such of their members as may be affected by any of the possible limitations on highway and domestic lighting. In addition, they hope that the Association of Public Lighting Engineers will consider the feasibility of the introduction by local authorities of by-laws controlling the erection and operation of illuminated signs. They would be grateful, also, if the British Standards Institution would invite the Committee appointed to deal with aeronautical ground lighting to consider whether the Highway Lighting Committee should be approached regarding the desirability of amending specifications for highway lighting to include any agreed restrictions.

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LIGHTING UNDER POST-WAR CONDITIONS

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The Hope of Post-War Sources

In what follows we give a summary of a contribution by Samuel G. Hibben, Director of Applied Lighting in the Westinghouse Electric Corporation (New Jersey, U.S.A.). The contribution appeared originally in *The Frontier*, published by the Armour Research Foundation, and whilst naturally based on American practice has also a general application to developments in this country. Mr. Hibben is well known to I.E.S. members, to whom he gave an address in 1934, and they had recently the pleasure of welcoming him again, at the annual general meeting in May last.

Amongst the many problems receiving constant attention to-day is the very vital one of transferring electrical energy directly to radiant energy without the intermediate step of heat. The objective is old, but several recent approaches are new. When this war began, some 95 per cent. of the man-made light sources were tungsten filament lamps, having their optimum economic light emission when the filaments were operated at a temperature of approximately 3,000°K, and whereof the heat losses were on the order of 90 per cent. of the input energy. This did not seem good enough.

The commercial tungsten filament lamp, with its efficiency of some 14 lumens per watt where 7.5 per cent. of the input energy is converted into radiation to which the human retina responds, may well remain a standard article for household use and for small wattage local industrial lighting equipment, but the urge for interior large-scale lighting and for illumination levels on the order of 50 to 100 ft.c. demand that higher efficiencies be attained. How high are our hopes?

Romantically, the scientist turns again to studies of the firefly, of luminescent bacteria, and of chemi-luminescence or bioluminescence in Nature. It is roughly estimated that 90 per cent. of the radiant emission from a firefly is luminous, closely approaching 500 lumens per watt. (Fig. 1.) This is ten times the ultimate efficiency that could be expected from a tungsten filament lamp since tungsten, when melting at about 3655°K. could generate visible light at no better than 55 lumens per watt. If such a lamp were to burn for several hours an efficiency of 35 lumens per watt would more correctly represent a practical top limit.

Like the firefly, most of Nature's lamps produce light by oxidation. No energy whatever is wasted in the production of invisible ultraviolet light, and practically none in heat radiations. Man's latest lamps willy-nilly generate much of both.

It appears that Nature's illuminants developed simultaneously with Nature's seeing organs. The luminous emission from a typical insect like the firefly is confined to a very narrow band of wave-lengths, concentrated at the central point of the visible spectrum or at the light yellow-green colour region (5700 A) where the response of the retinal nerves is most sensitive. Little or nothing is lost in emitting red or blue colours. By contrast, man's illuminants, particularly those of the hot body or incandescent types, emit a great deal of light at the long wave and also the short wave ends of the visible spectrum, and it is this radiation which, in addition to the infra-red and ultraviolet, is generally wasted so far as seeing is concerned.

From a study of the colour response characteristics of the human retina we might conclude that the sodium vapour lamp, for instance, which concentrates practically all of its luminous output at a wave-length of 5890 A (lemon yellow) would be the best light source for general purpose seeing. However, a study of this and other almost monochromatic lamps indicates one further difference between Nature's illuminants and man's. The purpose of the latter is to make surrounding objects visible by light reflection therefrom, whereas Nature's lamps are primarily to be seen as signals, or markers, or lures. Man's seeing judgment depends to a large extent upon the colour of the object being viewed, and hence a monochromatic source with its resultant distortion of object colour fails to meet our broad criteria for the ideal illuminant of tomorrow.

When we employ the energy of electricity to displace or excite the outermost electrons of the mercury atom within the commercial tubular fluorescent lamp, thereby generating short-wave ultraviolet radiations, and when this radiation in turn upsets the normal

Fig. 1. The "cold light" of a firefly is reproduced in a picture during a lecture by Samuel G. Hibben, who is shown with the pitcher and glassful of "cold light" obtained by mixing phosphorescent liquids.

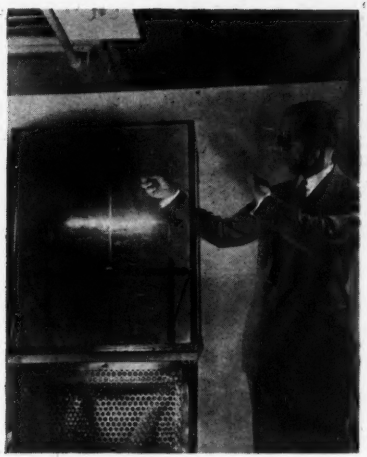

Fig. 2. Mr. Hibben is here demonstrating a 10,000-watt mercury vapour lamp, so brilliant that this picture had to be taken through a special glass filter screen; it radiates enough heat to light a cigarette held near it, although the quartz tube in which the light is generated is cooled by a continuous flow of cold water. This 10-kilowatt light source has a brilliance one-fifth that of the sun. In smaller sizes—up to 3,000 watts—such lamps are now used to light high bays and aisles in war plants.

atomic arrangement of the phosphor crystals coated on the inside of the glass tube, we have achieved a "short-circuiting" light-making process, i.e., we eliminate the production of much heat. By this method some 18 to 20 per cent. of the input energy is converted to usable light. This still seems not good enough.

An arc discharge through high pressure mercury vapour ranging from one to perhaps 80 atmospheres (but commercially at about 3 to 5) develops luminous radiation at a commercial efficiency on the order of 65 lumens per watt. (Fig. 2.) This is better, and further research will increase this efficiency in proportion as we can increase the temperature and pressure of the mercury vapour. The problem here is the refractory characteristic of the container. Summing up the situation we then have this analysis:—

1. Tungsten filament illuminants now developing some 15 lumens per watt and practically limited to 35 or to a theoretical and ultimate maximum 55.
2. The fluorescent lamp, now developing some 45 to 60 lumens per watt and capable of doing roughly twice as well, as the technique of developing 2537 A ultraviolet from mercury vapour and of efficiently exciting phosphor crystals therewith is perfected.
3. High pressure metallic vapour discharge lamps now producing 55 to 70 lumens per watt and theoretically capable of going considerably higher in efficiency if refractory containers could be had so as to permit increases in temperature that accompany pressure beyond roughly five atmospheres.

These, then, are some of the present-day problems in lighting research that seem to offer a challenge to the engineer who recognises that post-war lighting requirements will demand vastly more artificial illumination than man has heretofore enjoyed.

Brightness, Well-Being and Work *

By H. C. WESTON

In a contribution under the above title, recently reprinted from the *British Journal of Industrial Medicine*, Mr. H. C. Weston gives an admirable account of "background factors" affecting the artificial lighting of factories. He recalls that it was not until the Factories Act of 1937 that statutory provisions requiring adequate and suitable lighting were introduced—though during the 30 years that have elapsed since the first appointment of a Departmental Committee to inquire into this subject much useful work has been done and considerable improvement made.

Although recommendations usually relate to illumination in foot-candles, it is *the brightness* that really determines the *ease of seeing*, which it is our aim to secure. (Needles can be threaded all day by quite low illumination, provided we do not mind how slowly the work is done, nor how much time is spent in unsuccessful attempts, nor how much the eyes burn and ache at the end of the working day!)

Mr. Weston covers familiar ground in explaining the basis of analysis of the visual task. He illustrates, by numerous diagrams, the effect of increasing brightness on visual performance and the importance of such factors as size of object, contrast, etc. An important point to consider is that the "critical detail" may exist only momentarily, not throughout the entire working period (threading a needle is a case on point). Dealing with the effect of increasing intensities he establishes the all-important point that it is the *ratio* of two intensities and not the arithmetical difference that determines results. Hence successive equal increments in illumination become progressively less effective and ultimately too small to make any appreciable difference. Visual acuity is, in fact, proportional to the logarithm of brightness and continues to improve up to illuminations of the order of 1,000-foot candles (though, as noted above, the increase when the higher values are reached is but small). Considerable changes in illumination are, however, needed to bring about quite small changes in visual acuity. It may therefore be much more economical to obtain the greater ease of vision by increasing the size of the object (e.g., by magnifying glasses). This fact Mr. Weston illustrates by effective diagrams. In the same way a judicious increase in contrast may save much light—and eye-strain.

Another factor, not much studied as yet and difficult to separate from others, is the effect of movement. Much the same relation that applies to illumination and visual acuity comes into action when we consider work done, and Mr. Weston reproduces some familiar data showing the effect of illumination on weaving, typesetting by hand, and other operations.

Bad lighting, whilst necessarily an obstruction to visual acuity, also gives rise to disagreeable feeling—described in an extreme case in one of Poe's tales as "the eyes straining from their sockets." This sense of strain affects the emotional life, allowing the seeds of discontent to germinate and producing habitual depression. The gloom of blacked-out factories during the war period sometimes had an unfortunate effect—a sense of being "cut off" by the areas of darkness which is highly prejudicial to the team spirit. At the other end of the scale we have the feeling of being "on top of the world" on clear days of bright sunshine. This state of feeling may influence movements, speeding up even mechanical operations.

All the above leads to an analysis of the basis of the I.E.S. Code and the recognition that a specified value of illumination should be sufficient to ensure a good proportion (e.g., 93 per cent.) of the performance possible with ideal conditions. Such a proportion may be realised in some circumstances with the minimum of 6 ft.c. now recommended as the legal minimum in factories, though for the more exacting forms of work higher values may be expedient.

The benefit of high illumination presupposes that other good conditions, e.g., absence of glare, are also present. In this connection Mr. Weston has an instructive diagram showing how rate of working can be affected by the presence of dazzle. In the case examined, the performance of women examining cartridge cases, glitter from the brass

* Summary of a contribution to the *British Journal of Industrial Medicine*, Vol. 1, No. 3, July, 1944.

caps of the cases made the task of inspection more difficult and fatiguing by artificial light than in diffused daylight. Reflected glare is of frequent occurrence in industry, but can be mitigated by the use of indirect lighting or luminous panels or other secondary light sources of low brightness.

Mr. Weston deals briefly with diffusion and shadow, pointing out that whilst the presence of dense shadows is generally unpleasant and sometimes inconvenient, lighting from a particular direction is sometimes expedient (e.g., in the textile industry). The soft shadows yielded by the fluorescent lamps and the resemblance of the colour of the light to daylight are great advantages, more especially when the artificial light is used to supplement daylight, and the low brightness is very helpful in diminishing both direct and reflected glare. A brief reference is made to possible stroboscopic effects with such lamps, when used to illuminate moving objects. There are, however, several ways of minimising this effect, for example, by arranging for the cyclical variation of light from adjacent lamps to be out of phase.

Mr. Weston devoted the final section of his contribution to the importance of background. Light coloured surroundings help considerably to reflect and diffuse light, thus adding to the available direct illumination. In this respect, as Mr. Weston truly remarks, "even a dirty light colour is brighter than a dirty dark colour and dark colours do nothing to encourage cleanliness. There is much to be said for the recommendation of the Departmental Committee on Lighting in Factories that walls, partitions, and other structural features less than 20 ft. above floor level should be maintained light in colour.

The use of light shades of colour for the decoration not only of surroundings but for portions of machines has recently been adopted with good effect, making the interiors of factories less grim and forbidding (such as the "dark Satanic mills" of which Blake wrote). Gay colours are commonly used for agricultural machinery used out of doors in full daylight. Why should machines used indoors be so commonly painted black or dark grey? The adoption of light contrasting tones led workers in one instance to describe the interior humorously as "the dairy," which is certainly more complimentary than the description of a particularly gloomy one, by another set of workers, as "the dump."

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Physics Department.

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COUNTY COUNCIL OF THE COUNTY OF LANARK

Assistant County Lighting Engineer.

Applications are invited for the appointment of **Assistant** to the **County Lighting Engineer.** Applicants should have extensive knowledge of the design, erection and maintenance of Public Lighting Installations, both by gas and by electricity, and should have experience in the preparation of specifications and schedules of quantities, and should be neat draughtsmen.

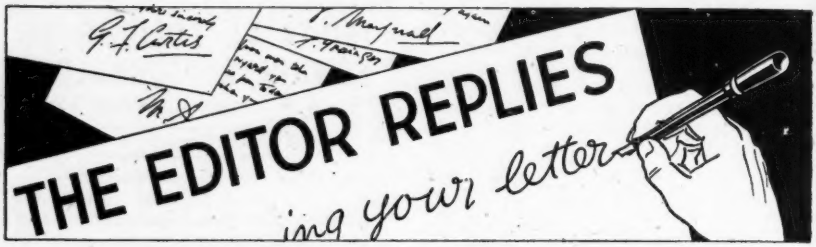
The successful candidate will require to pass a medical examination and contribute to the County Councils Superannuation Fund.

Applications should be in writing and should state:—

(1) Full name; (2) Date of Birth; (3) Education, training and qualifications; (4) Details of past experience; (5) Present appointment; (6) Salary expected; (7) Position under the Control of Engagements Order, 1945.

Applications should be accompanied by three recent testimonials, and should be posted to reach the **County Clerk, Lanarkshire House, 191, Ingram Street, Glasgow, C.1.**, not later than **Saturday, 3rd November, 1945.**

Members of H.M. Forces are specially invited to apply: Lanarkshire House, 191, Ingram Street, Glasgow.



I have been favoured by a copy of a leaflet on Industrial and Welfare Accommodation, issued by the **Post Office Engineering Union,** which contains a section on lighting. One is very glad to note the inclusion of this important amenity, together with others. In general the suggestions appear to be sound and, in some cases, more generous than might be expected., e.g., the proposal of 20 ft.c. for the working illumination in factories, in addition to the general value of 6 ft.c.

Elsewhere allusion is made to the value of high windows and the use of light-coloured decoration, and the avoidance of glare. All this is sound, though I am not so sure of the recommendation that windows should be glazed with **a type of glass that does not impede ultra-violet rays.** This seems a more debatable step, from the standpoint of expediency as well as expense.

Where I am inclined to join issue with the writer, however, is in the section commenting on the **fluorescent lamp.** After alluding to its advantages, e.g., natural colour and softness of effect, the pamphlet refers to "pronounced stroboscopic effects" (in practice surely not a very serious drawback) and finally to its **conjectural prejudicial effect on vision** ("because it is monochromatic it may cause as yet unascertained strain on the eyes . . ."), and calls for medical inquiry and reassurance.

Here, surely, the writer is quite at sea. So far from being monochromatic the lamp yields a spectrum approaching quite closely to that of daylight, and although, certainly, a few cases of people who apparently suffered eye trouble after working with these lamps for some time have been noted, on the other hand many thousands have done so continuously without ill effect and apparently with benefit.

I dwell on this because there seems to be a mistaken tendency, also discussed in our last issue,* to assume the need for a medical inquiry even before any appreciable evidence of injury is available. Those familiar with **successive advances in illuminants** since the days of the flat flame gasburner and the carbon filament electric lamp will recall that each **new development** was greeted with **some degree of apprehension**—a rather odd illustration of conservatism in regard to new methods.

Some interest has been expressed in the type of **fluorescent lamp in circular form,**† just recently introduced in the United States. I notice in the I.E.S. Lighting Review (Australia) a picture of the Board Room at the new Royal Melbourne Hospital in which pendant fittings of this type are mounted on the ceiling, furnishing 12 ft.c. with a load of 1,000 watts.

Whilst probably not so efficient as the long linear type of lamp these ring-shaped fittings have certain advantages,

* Is there anything wrong with Fluorescent Lighting? ("Light and Lighting," July, 1945, p. 95.)

† "Light and Lighting," July, 1945, p. 99.

making a more pleasing impression, especially in rooms of limited dimensions, and possibly giving better shadow conditions.

I have heard from friends from the country who have only recently revisited London, expressions of wonder at **the restoration of street lighting** comparable with that in pre-war days. People all seem to be grateful for the return of normal lighting. There is no reaction against the brilliance such as some predicted as a result of prolonged experience of the black-out.

We notice in *The Star* a tribute to the **lighting in Sheffield,** which has enjoyed a full month of restoration of pre-war conditions. As it has been necessary for the public engineer, Mr. J. F. Colquhoun, to check up on some 660 miles of streets the restoration has been something of a feat, especially in view of the present shortage of labour. It is stated, however, that in a week-end tour of 60 miles Mr. Colquhoun found only half a dozen defective lamps—a smaller percentage than in pre-war days. I should be glad to hear experience from other cities.

Gratitude for this restoration of public lighting is, however, tempered by the request recently put out by the Ministry of Fuel and Power, suggesting that **Authorities should consider economies,** should not turn on lights earlier in the evening than is strictly necessary, and, as a general rule, should extinguish them at midnight.

We are all well aware of the anxiety caused by the low level to which stocks of coal have fallen. Yet this idea of economising in street lighting, in order to save coal, has often been raised and, I believe, most public lighting engineers believe that the possible economy is small in comparison with the danger to safety of extinguishing street lamps—probably much smaller, even, than a superficial examination of gas or electricity saved might suggest.

Even after experience of the results of the black-out there is still a certain impression that lighting in the streets is a luxury, or at least an amenity we can do without. A further unfortunate result of this request may be that various **lighting authorities will form their own opinions** of what is expedient, so that in London, at any rate, practice in adjacent areas may well vary considerably, and drivers may find themselves passing from a brightly lit district into one in which obscurity prevails, or *vice versa*.

If this view is taken of public lighting it would seem that the prospect of **lighted shop windows, illuminated signs** and other supplementary aids to brightening the streets being permitted is not very hopeful. Possibly, however, some concessions may at least be made during the Christmas season.

My attention has been drawn to another debatable point in style. We say, "I am very pleased to report . . . " but "I am very **much** obliged. . . ." In what circumstances is "much" really necessary? It is not habitually used after "very," though I have a feeling that—although its general use would sound pedantic—it is strictly correct.

SITUATIONS VACANT

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CLOCKWORK CONTROLLERS for Public Lighting, Clocks, Control and Time Switches, Electric Clocks, and all types of instruments and appliances operated by clockwork, repaired and overhauled. Inquiries welcomed.—J. W. and R. E. Hughes (Clockwork Engineers), 58, Victoria-street, London, S.W.1. Phone: Victoria 0134.

Fluorescent Lighting for Railway Coaches

Reference has been made recently in the daily Press to the fluorescent lighting which the Great Western Railway Company intend to install in their new coaches.

The system has been developed by the British Thomson-Houston Co., who supplied the equipment for a trial installation. The lighting layout was prepared jointly by G.W.R. and B.T.H. engineers.

Power is taken from the existing lighting set and battery, which feeds a motor-alternator set, generating currency at a frequency of 400 cycles. The reason for the choice of this high frequency depends on a number of factors, but one of the advantages is the reduction in weight and size of gear as compared with that which would be required on a normal 50-cycle supply.

Some increase in illumination is obtained by the use of fluorescent lamps, but the most marked advantages in the adoption of this type of lighting lie in the reduction of glare and the softness of the shadow conditions.

In the past the usual method of lighting involved a combination of overhead lighting with back of seat lighting, but with filament lamps it is difficult under these conditions to avoid some degree of discomfort glare from the back of seat fittings. It has been found possible to reduce this very considerably by taking full advantage of the shape and low brightness of the fluorescent lamp and the effect generally is pleasant and restful to the eyes.

Lt.-Col. Geoffrey Falk, T.D., M.I.E.E., has now been released from the Army and will resume his duties with Falk Stadelmann and Co., Ltd., on September 1, 1945. Colonel Falk served in R. Signals, and immediately prior to demobilisation was on the Staff of H.Q. Berlin District B.L.A.

Gas Lighting for Single Family Dwellings

Gas lighting for single family dwellings forms the subject of another British Standard Code of Practice (CP. 1945) recently issued for comment. This is one of a series of codes on gas installation prepared by a committee convened by the Institution of Gas Engineers on behalf of the Codes of Practice Committee. The code consists of eight sections, of which the first deals with scope, definitions, and terminology, etc., and the second with materials, appliances, and components. [We notice the judicious hint (par. 103) that "consultation with a lighting engineer at an early stage in planning is recommended."]

Section 3 (Design Considerations) occupies the bulk of the booklet. The standards of illumination here specified are in accordance with those in Chapter VII (F) of the Code of Functional Requirements of Building; Provision of Artificial Light and the present code aims chiefly at suggesting ways and means of securing these standards. This is done in turn for various domestic interiors, the number and nature of points and their positions being stated in each case. In general, 6-10 ft. c. is advised, but in a few instances of special work (sustained reading and homework) 10-15 and in the case of sewing 15-20 ft. c. are recommended. Living rooms, kitchens, combined kitchens, and general living rooms, bathrooms, and bedrooms are thus treated. Some suggestions are also made in regard to the lighting of stairs and passages. A table showing the light output from typical single and multiple arrangements of mantles is given. The final sections deal with work on site, inspection and testing, and maintenance. In the appendices charts showing how to determine the size of lighting units for living rooms are presented.